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EXAMINER	
KIELIN, ERIK J	

ART UNIT	PAPER NUMBER
2813	8

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

Office Action Summary	Application No.	Applicant(s)
	09/893,035	CHO, HAG-JU
	Examiner	Art Unit
	Erik Kielin	2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 July 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-13* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-13* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 6 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in-
> (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or
> (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

2. Claims 1, 2, 9, and 11-13 are rejected under 35 U.S.C. 102(e) as being unpatentable over Patent Application US 2001/0006835 A1 (**Kim** et al.).

Regarding claims 1, 9, 11, and 12, **Kim** discloses a method of treating an integrated circuit device comprising,

forming an insulation layer **122A** that comprises oxygen between upper **124A** and lower **120A** conductive layers, the insulation layer having a first surface portion that is exposed by the upper and lower conductive layers and a second, non-exposed, surface portion (Fig. 1B; ; and

exposing the insulation layer **122A** to a metal precursor that is reactive with oxygen (modified trimethyl aluminum, as further limited by instant claim 9) so as to form a first metal oxide layer **140** (Fig. 1C) on the exposed portion (i.e. the first surface portion of the insulation layer) without forming the first metal oxide, which may be aluminum oxide (Al_2O_3), on the covered portion (i.e. the second surface portion of the insulation layer), wherein the insulation layer may be formed from aluminum oxide (Al_2O_3) (as further limited by instant claim 12) and

wherein the insulation layer **122A** may be a capacitor dielectric (as further limited by instant claim 11); and then providing an "oxygen treatment" for the metal-oxide-coated integrated circuit in using N_2O or ozone atmosphere so as to remove carbon contamination and to densify the Al_2O_3 (paragraph [0018]). (See also paragraphs [0014]-[0021].)

Regarding claim 2, the first metal oxide layer **140**, Al_2O_3, is deposited by ALD, wherein the integrated circuit is exposed to a metal precursor pulse for various exemplary times of 0.1 to 3 seconds using flow controllers followed by purging with inert nitrogen gas. (See paragraphs [0016]; Fig. 2.)

Regarding claim 13, because the layers are built up layer-by-layer (paragraph [0017]), each additional monolayer layer encapsulates the layer before it. Accordingly, the first metal oxide layer and the insulation layer are necessarily encapsulated by a second metal oxide layer, by virtue of the method by which ALD works.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 3, 4, and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Kim** in view of US Patent Application 2001/0024387 A1 (**Raaijmakers** et al.).

Regarding claims 3 and 4, **Kim** teaches a first exposure to a metal precursor followed by purging with nitrogen wherein each pulse is from 0.1-3 seconds which overlaps the instantly

claimed pulse time ranges. **Kim** also teaches that the flows of all gases are regulated using a flow controller, so that some flow rate must be used, although the specific amount is not indicated.

Raaijmakers teaches a very similar method for ALD deposition of aluminum oxide for capacitor applications. **Raaijmakers** teaches pulse times for both the metal precursor and the inert purge gas falling within Applicant's claimed range of 0.1-2 seconds and 0.1 to 10 seconds, respectively. The metal oxide is by atomic layer deposition (ALD) wherein the integrated circuit is exposed to a metal precursor pulse for various exemplary times of 0.1 to 1 seconds at exemplary flow rates of 20 to 40 sccm and then exposed to pulses of carrier gas at an exemplary flow rate of 400 sccm for periods of 0.2 to 6 seconds to remove the un-reacted metal precursor. (See Tables I-VI and paragraphs [0071] to [0086].)

Although the deposition parameters are not as exactly claimed by Applicant, **Raaijmakers** states

> "Note that the parameters in the tables below are exemplary only. Each process phase is desirably arranged to saturate the bottom electrode surface. ... In view of the disclosure herein, the skilled artisan can readily modify, substitute or otherwise alter deposition conditions for different reaction chambers and for different selected conditions to achieve saturated, self-terminating phases at acceptable deposition rates." (See paragraph [0085].)

In light of the forgoing, it would be wholly obvious for one of ordinary skill in the art, at the time of the invention, to use optimize the flow rates and pulse times around those taught by RAJ in the method of Kim, in order to achieve the saturation of the surface of the exposed dielectric in order to achieve acceptable deposition rates, as taught by **Raaijmakers** for a given reaction chamber. One of ordinary skill would be further motivated to optimize the conditions of deposition for a specific metal oxide being formed depending upon the amount of exposed

surface being coated and upon the reaction apparatus being used, as suggested in **Raaijmakers**. (See MPEP 2144.05.)

Regarding claim 5, although **Kim** does not indicate if the metal precursor is diluted with a carrier gas, **Raaijmakers** teaches that the metal precursor pulse is provided along with N_2 carrier gas. (See Tables I-VI.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to dilute the metal precursor of **Kim** with N_2, as taught by **Raaijmakers**, in order to better control the total amount of metal precursor in the system and because this is standard operating procedure in ALD to control the total rate of flow and to not waste expensive metal precursors, and to allow less contamination of the ALD reaction plumbing.

5. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Kim** in view of Patent Application US 2001/0041250 A1 (**Werkhoven** et al.).

The prior art of **Kim**, as explained above, discloses each of the claimed features except for indicating that the carrier gas is argon, Ar.

Werkhoven teaches a very similar ALD method for treating integrated circuit devices wherein the carrier gas may be, inter alia, N_2 or Ar. (See paragraph [0061].)

It would be obvious for one of ordinary skill in the art, at the time of the invention, to use Ar in **Kim** as a matter of design choice because it would appear that argon would work just as well as nitrogen being that each is inert in the process and because, as taught by **Werkhoven**, Ar is a common carrier gas for ALD.

6. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Kim** in view of US 6,335,240 B1 (Kim et al.; **Kim 2**, hereafter).

The prior art of **Kim**, as explained above, discloses each of the claimed features except for indicating the conditions of the disclosed oxygen treatment of the metal oxide Al_2O_3 film.

Kim 2 teaches annealing conditions for ALD deposited Al_2O_3 films using O_2 at a temperature of 150-900 °C with exemplary embodiments at 450 °C, which falls within Applicant's claimed range of 400-600 °C. (See **Kim 2**, Abstract; col. 8, Table 3).

It would be obvious for one of ordinary skill in the art, at the time of the invention, to use the densification treatment of the aluminum oxide provided in **Kim 2** in the method of **Kim** because **Kim** did not specify conditions and the conditions in **Kim 2** are specifically for ALD formed Al_2O_3 in order to densify the film which is desired in **Kim**.

Although the time is not as exactly claimed in claim 8, the choice would be a matter of routine optimization with a single variable. One would be motivated to find the time required to densify the thin film in **Kim** for the specific purpose therein. Inasmuch as both **Kim** and the instant invention deposit the Al_2O_3 layer over the insulating layer of a capacitor as a hydrogen diffusion barrier, the layers serve the same purpose, so one of ordinary skill would be motivated to densify the Al_2O_3 for the period of time required to optimize the densification for the required purpose in **Kim.** Furthermore, because **Kim** is not limited to some period of time or temperature at which the Al_2O_3 layer is treated for the purposes indicated therein, one of ordinary skill would be motivated to optimize the process and thereby determine the required time and temperature ranges. (See MPEP 2144.05.)

7. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Kim**.

The prior art of **Kim**, as explained above, discloses each of the claimed features except for indicating the pressure and temperature range (claim 10) for the deposition of the metal oxide. **Kim** does, however, disclose a reaction temperature of 200 - 450 °C, which overlaps the claimed range of 100 - 400 °C, and a pressure range of 0.05 - 0.3 Torr, which overlaps the claimed range of 0.1 to 1 Torr. Although these ranges are not exactly as claimed, it would be obvious to optimize the range for depositing a given metal oxide layer under given conditions depending upon the total exposed surface area of the insulation layer being treated and depending upon the reaction chamber. One of ordinary skill would be motivated to optimize the conditions for the reason indicated above. (See MPEP 2144.05.)

8. Claims 1-6, 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's submitted reference, **KR 2000-25706**, in view of US 6,203,613 B1 (**Gates** et al.).

Regarding claim 1, **KR 2000-25706** discloses the insulation layer **14**, upper **16** and lower **12** electrodes, wherein only the portion of the insulating layer **14** exposed by the upper and lower electrodes is covered with a first metal oxide **22** which serves as a reaction barrier layer to prevent damage to the insulating layer **14** during further processing.

KR 2000-25706 does not teach the method by which the insulating layer **14** is formed.

Gates discloses a method of treating an oxygen-containing insulation layer with a metal precursor reactive with oxygen using ALD to form single or plural layers of metal oxide. (See cols. 7-10.) **Gates**, moreover, says that the ALD method is useful for fabricating gate and

capacitor dielectrics and reaction barrier layers (col. 3, lines 20-25) such as the reaction barrier layer in **KR 2000-25706**, as noted above, used to protect the insulating layer **14** therein.

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use ALD and the ALD conditions in **Gates** for forming the reaction barrier metal oxide layers in **KR 2000-25706**, because **Gates** teaches that the method is good for forming reaction barrier layers in integrated circuits, such as those in **KR 2000-25706**.

Regarding claims 2, 5, and 6, pulsing metal precursor or diluted metal precursor and then inert carrier is shown in the examples as noted above (cols. 7-10) and argon as the inert gas is taught at col. 7, line 14.

Regarding claims 3, 4, and 10, although the conditions of pulse time, flow rates and temperatures are not exactly as instantly claimed, each of these parameter ranges overlaps or is nearby those in **Gates**, amounting to a matter of routine optimization. (See MPEP 2144.05.) It would have been obvious for one of ordinary skill in the art, at the time of the invention to optimize the ALD conditions of the **Gates** method for the application in **KR 2000-25706**.

Regarding claim 9, the metal precursors are taught in **Gates** at least at col. 4, lines 56-64.

Regarding claims 11 and 12, the insulation layer **14** of **KR 2000-25706** is a ferroelectric capacitor layer.

Regarding claim 13, the encapsulating oxide **18** is taught in **KR 2000-25706**. Also note, because the layers of the first oxide layer **22** in **KR 2000-25706** are built up layer-by-layer since ALD is used, each additional monolayer layer encapsulates the layer before it. Accordingly, the first metal oxide layer and the insulation layer are necessarily encapsulated by a second metal

oxide layer, by virtue of the method by which ALD works, even if the encapsulating layer is not considered to be **18**.

9. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over **KR 2000-25706** in view of **Gates** as applied to claims 1 and 2 above, and further in view of **Kim2**.

The prior art of **KR 2000-25706** in view of **Gates**, as explained above, discloses each of the claimed features except for thermally treating the integrated circuit device in oxygen.

Kim 2 teaches annealing conditions for ALD deposited metal oxide films using O_2 at a temperature of 150-900 °C with exemplary embodiments at 450 °C, which falls within Applicant's claimed range of 400-600 °C. (See **Kim 2**, Abstract; col. 8, Table 3).

It would be obvious for one of ordinary skill in the art, at the time of the invention, to use the densification treatment of the metal oxide provided in **Kim 2** in the method of **KR 2000-25706** in view of **Gates** in order to densify the ALD layer and thereby to provide better reaction barrier layer protection.

Although the time is not as exactly claimed in claim 8, the choice would be a matter of routine optimization with a single variable. One would be motivated to find the time required to densify the thin film in **KR 2000-25706** in view of **Gates** for the specific purpose therein.

Response to Arguments

10. The rejection under 35 USC 102(e) over **Raaijmakers** is moot in view of the amendments to the claims.

11. Applicant's arguments filed 18 July 2002 with respect to Kim have been fully considered but they are not persuasive.

Kim clearly teaches each of the features of the amended claims, as indicated above in the rejection. Applicant's argument regarding Applicant's definition of "on" is irrelevant here and grossly in error. First, Applicant cannot selectively pick which of the two definitions given for the term "on." Furthermore, by Applicant's own erroneous reasoning, Applicant's own Fig. 2 and 3 clearly meet the selective definition of "on" which Applicant argues is only in Kim. Note that the horizontal portion of the ALD layer 200, 200'in Applicant's Fig. 2, by Applicant's selectively argued definition, meets the condition of " 'on' the second surface" (unexposed surface) because the insulating layer --itself-- intervenes and therefore the layer 200,200' qualifies as "on" the second surface of the insulating layer. For this reason, Applicant's argument is considered erroneous.

Further in this regard, note that while Applicant may be his or her own lexicographer, a term in a claim may not be given a meaning repugnant to the usual meaning of that term. See *In re Hill*, 161 F.2d 367, 73 USPQ 482 (CCPA 1947). Accordingly, Applicant cannot selectively decide that known definitions of "on" are improper. It is, moreover, simply improper for Applicant to selectively decide that "on" does not, now, mean "directly on" in contradiction to Applicant's own specification.

Conclusion

12. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. AND Applicant's submission of an information disclosure statement under 37

CFR 1.97(c) with the fee set forth in 37 CFR 1.17(p) on 5/2/02 prompted the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached at (703) 306-2794 or by e-mail at olik.chaudhuri@uspto.gov. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

EK

September 26, 2002

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